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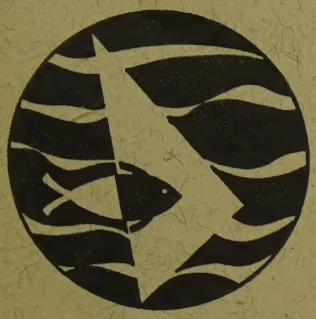

A MODEL FISHERY PRODUCTS QUALITY CONTROL LABORATORY

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 1971

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prepared by

Fishery Products and Marketing Branch
of
Fishery Industries Division

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 1971

Preparation of this document

Requests for help in the design and equipment of quality control laboratories are frequently received from government authorities, industry and international technical assistance projects concerned with the utilization of fish and fishery products. The establishment of quality control facilities is an important step in the development of the fishing industry of a country and for this reason the preparation of this paper was included in the programme of the Fishery Products and Marketing Branch.

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INTRODUCTION

The establishment of a fishery products quality control laboratory is a very important step in the development of a fishery industry of a country. The Fishery Industries Division of FAO has been asked, on several occasions, to advise on the layout or equipment of such laboratories, either by Government authorities, industries or international technical assistance projects concerned with the utilization of fishery products. The Fishery Products and Marketing Branch has therefore developed a model laboratory as a guide. Particular emphasis has been given to specific design considerations for the premises, to a detailed description of equipment, and to the safety arrangements in such a laboratory.

The model laboratory has been designed using advice from long-established fish inspection services of selected countries and experience gained by visits to quality control laboratories serving the fishery industries or governmental services in Europe. The laboratory has been planned to carry out basic sensory, physical, microbiological and chemical examinations of fresh and frozen fish, salted, dried, smoked and canned fish products, and to assist with plant sanitation by rapid routine analytical methods, rather than by reference analytical methods.

A professional microbiologist and a chemist, with a fish inspector, chemistry and microbiology technicians, a clerk-typist and three semi-skilled helpers will constitute the basic staff of the laboratory. Provision is made for two professionals and three technicians to join the basic staff as trainees.

PREMISES

The chief objective of the development of a model laboratory is to give general guidance and to provide a check-list for those involved in the design and construction of appropriate premises. The advice given on premises may be read with this in mind and modifications made where necessary.

Site

The location of the laboratory should be decided after careful study of the most important present and/or planned fishery industry centres as well as fish marketing centres in a country. The work of such a laboratory may be facilitated often if it is situated in the vicinity of other laboratories or applied research institutes.

A decision on local siting should be made after an examination of various factors such as public water, electricity and gas supplies. Availability of maintenance workshops and public sewage systems should also be considered. The ground for the laboratory premises should be at a reasonable distance from any source that might cause vibration of the building, such as railways and roads carrying heavy vehicles, etc.

Construction

The size of premises should be adequate to cover the present needs as well as those which might be expected in the immediate future. For a laboratory with facilities similar to the model, a covered area of from 200 to 300 m^2 should be considered. When planning the premises, provisions should be made for extending this area, either horizontally or vertically or in both directions at a later stage, when the work of the laboratory increases.

The orientation of certain rooms in the laboratory should be taken into consideration whenever possible, e.g. chemical and biological laboratories, as well as the weighing rooms, should be oriented toward the north; this also applies to any room using optical and electronic instruments, if not located in the middle of the building. The number of rooms, of course, depends on the size of the laboratory. It is recommended, however, the microbiological and chemical laboratories each be accommodated in separate rooms, away from stores, etc. The total floor area and its division between the laboratories for this model is suggested in Annex 1.

The height of the laboratory rooms should preferably be more than 3 m, the floors lined with a chemical-resistant material, easy to clean and wash; walls are best lined with tiles up to the ceiling or at least up to the height of 1.75 m. The remainder should be white-washed.

The most convenient type of internal doors is the swing type. Sliding windows with window screens are also most convenient. The number of persons working in a single research laboratory space should be from two to a maximum of four.

Utilities

Water supply should be of a constant dependable pressure not lower than 2 kg/cm^2 and be able to deliver 30 l/min; the total water consumption of the laboratory should be estimated at about 5 $m^3/24$ h. Consideration should be given to providing an emergency water supply whenever pressure failure would create hazards. The system of heating water and distribution for hand washing and glassware washing purposes should be selected so as to meet the most practicable local conditions. Power supply should be of a constant voltage; variations of voltage greater than $\pm$ 5% are not desirable. If the variations in voltage are greater, readings from some electronic instruments will not be accurate and, in some cases, electric devices could be damaged. In such instances, an adequate automatic transformer providing negligible variations in voltage should be incorporated in the power supply network of the laboratory. The power supply should be designed to ensure a capacity of not less than 15 kW/h for the initial period. Provision should however be made for an increased power supply at a later stage.

An ample supply of gas, preferably from a public gas supplier, is necessary. However, if this is not available, bottled liquified petroleum gas could also be used and distributed from the laboratory's own bottled gas station, which should be located outside the building, through an internal gas pipeline network to the rooms where it is needed.

Water, power and gas installations should be made from standard interchangeable parts mounted on the walls and not built-in. The reason for this is to facilitate repairs and modifications. Each installation should be painted with a different colour for easy identification.

Heating and air-conditioning systems for the laboratories should be provided with due consideration to the local climates. A test panel room should be air-conditioned in all climates. Temperatures below 15°C or above 25°C or relative air humidity above 70% cannot be tolerated within the laboratories. The laboratories in desert areas subject to sand storms should be suitably over-pressurized in order to prevent contamination by sand particles.

Adequate lighting of laboratories should be installed and should preferably be designed to provide 700 to 1 000 lm/m^2 in laboratories, offices and lecture rooms; 200 lm/m^2 in stairways, washrooms and other service areas.

EQUIPMENT - INDIVIDUAL ROOMS

General

Information on the dimensions of individual rooms and their relationship with other rooms is given along with suggestions for furniture and equipment. Safety equipment is included in the list for each room. The idea of how the laboratory furniture and equipment could be arranged in the rooms is given in Annexes 2 and 3.

For electrical equipment, a voltage of 115 V is given throughout the text. This has been done as a reminder that, whenever such equipment is ordered, the voltage and frequency of the electrical power source available should be specified, and does not infer a recommendation of this particular voltage.

The majority of prices quoted have been taken from a 1970 catalogue of laboratory equipment published by a commercial firm. The prices are given in U.S. dollars as accurately as possible but they should still be considered as only approximate. It should be borne in mind that prices are subject to change and that neither discount nor freight costs are taken into consideration. The actual prices for furniture offered by different suppliers vary considerably more than those for equipment.

Lists of suppliers of relevant equipment, furniture and chemicals are often published in scientific periodicals.

Fish examination room

This room is for the examination of fresh and frozen fish, and serves as a work area for trials on handling, packing and storage of fish as well as for demonstrations of relevant techniques and inspection routines. The minimum floor area of the room should be 6 x 6 m = 36 m^2, but a larger room, up to 9 x 7 m = 63 m^2, is preferable. The room should have ample windows and a door opening of at least 90 cm wide, its floor should be non-porous, washable and well-drained, and the walls smooth and waterproof. All junctions between floor and walls should be coved. Electric power points should be properly earthed and made waterproof.

Furniture	U.S.$
-table with plastic top and metal corrosion protected legs, 4 x 0.9 x 0.9 m	150
-candling table with opaque glass top, electric bulb 20 W, 115 V underneath the top, and a switch. Electric installation according to standards for wet spaces, 0.9 x 0.9 x 0.9 m	100
-2 wall cases with glass sliding doors, 1.2 x 0.3 x 0.75 m ($127 each)	254
-inclined desk with 1 drawer, 0.9 x 0.6 x 1.2/1.3 m	70
-sink basin of corrosion, heat, shock, and abrasion resistant plastic, 60 x 40 x 20 cm	80
-double faucet for the sink basin, with gooseneck and serrated hose connector	29
	$683

Equipment	U.S.$
-household type freezer, -25°C, 360 l, 2 front doors, 115 V	300
-household type refrigerator, 360 l, with built-in humidifier, without freezer compartment, 1 front door, 115 V	300
-filleting table with a trough, a set of removable plastic filleting boards, a set of removable perforated stainless steel plates, water supply and drainage system, 3 x 0.8 x 0.9 m overall	300
-direct reading balance, 5 kg x 1 g, corrosion resistant, with damper	260
-pH-metre for industrial applications, portable, complete with combination electrode, electrode holder, buffers, range 0-14 ± 0.1 pH, 115 V	230
-resistance thermometer, portable, with standard probe for fish, -35 to 20°C, battery operated	100
-electric drill, portable, with a drill set for drilling fish, 115 V	35
-6 mercury-in-glass thermometers, -40 to 50 ± 1°C ($5 each)	30
-2 fish bone cutting knives, 22.5 cm long	15
-10 fish filleting knives, 10-17 cm long, assorted	15
-5 trays, stainless steel, with cover, 23 x 14 x 5 cm ($7 each)	35
-20 fish boxes, plastic, capacity 30 l, 80 x 45 x 15 cm	60
-polyurethane foam insulated fish box, with insulated lid, handles for lifting and ice melting water drain collector, on castor wheels, 0.6 x 0.6 x 0.7 m overall	75
-5 waste baskets, polyethylene ($3 each)	15
	$1 770

Test panel room

This room serves to carry out sensory evaluation of fresh fish and fish products for products development and inspection activities. The room area should be 6 x 3 = 18 m^2 to accommodate 6 panelists. There are 6 pass-thru openings from this room to the complementing test kitchen.

Furniture	U.S.$
-1 set of 6 booths for panelists, 0.8 x 0.5 m table surface per panelist, each booth has a pass-thru opening to the test kitchen with sliding shutter, booths lined with white-grey plastic, a 20 W daylight illuminating tube, 115 V	300
-laboratory desk with drawers on both sides, metal construction, 1.1 x 0.75 x 0.75 cm	190
-7 upholstered chairs, adjustable height, quiet-running wheels on ball-bearing castors ($44 each)	308
	$798

Equipment	
-air conditioner, to automatically keep the temperature and relative air humidity at pre-set levels, with a dust filter built in the fresh air intake duct	300
	$300

Test kitchen

This kitchen serves for the preparation of samples of fresh fish and fish products for sensory evaluation by test panel, and to carry out new products development work on a laboratory scale. The size of the kitchen should be approx. 6 x 3 m = 18 m^2. There are 6 pass-thru openings from the kitchen to the complementary test panel room.

Furniture	U.S.$
-sink assembly, complete with a basin, cupboard, plastic top, double faucet, 0.9 x 0.55 x 0.9 m	385
-5 table units, with 1.2 x 0.55 m, plastic tops and 2 drawers each; standing-height ($115 each)	580
-cupboard unit, with plastic top, 2-door storage space, 1.2 x 0.55 x 0.9	135
-2 wall cases with glass sliding doors, 1.2 x 0.3 x 0.75 m ($127 each)	254
-laboratory stool, high model, adjustable 55-75 cm	26
	$1 380

Equipment	
-household freezer, -25°C, 120 l, with plastic top, height 0.9 m, 115 V	150
-household refrigerator, 120 l, with plastic top, height 0.9 m, 115 V	150
-household electric stove, with 4 heaters on top, thermostatically controlled oven, timer, height 0.9 m, 115 V	150
-household dish washing machine, 115 V	150
-household automatic can opener, 115 V	10
-household kitchen exhaust hood, with fan	40
-water bath, electrically heated, 8 openings, 2 kW, 115 V	220
-60 china plates	50
-30 fireproof china dishes, assorted	300
-20 glasses	5
-60 pieces of cutlery, assorted	50
-fire extinguisher, for flammable liquid and electrical equipment fires, with 2.5 kg charge	27
-fire blanket, with wall case, all-wool fire-proofed, 2 x 1.5 m	42
	$1 344

Microbiological laboratory

This laboratory is used for the microbiological analysis needed to support plant sanitation, control of water supply, and applied research work for the fish utilization industry. Incubation tests of canned fish can be undertaken and assistance given to fish inspection services. The area of the laboratory should be approx. 5 x 4 m = 20 m^2 and one 5 m long wall should face north and be provided with ample windows. Other smaller rooms, a culture media kitchen, a glassware washing room, a store room, and service area, should be provided to complement this laboratory.

Furniture	U.S.$
-sink assembly, complete with a chemical resistant basin, cupboard, plastic top, double faucet, 0.9 x 0.55 x 0.9 m	385
-2 table units, with 1.2 x 0.55 m plastic tops and 2 drawers each; standing-height ($115 each)	230
-2 table units, with 1.2 x 0.55 m plastic tops and 2 drawers each; sitting-height ($110 each)	220
-cupboard unit, with plastic top, 2-door storage space, 1.2 x 0.55 x 0.9 m	135
-laboratory desk, with drawers on both sides, metal construction, 1.1 x 0.75 x 0.75 m	190
-chair, to match the desk, metal construction	58
-laboratory stool, high model, adjustable 55-75 cm	26
-laboratory stool, low model, adjustable 45-65 cm	23
	$1 267

Equipment (apparatus)	
-microscope, monocular, 3 objectives (dry, achr., 10 x and 45 x; oil immersion, achr. 100 x), Huygenian eyepiece 10 x, condenser, ungraduated mechanical stage, attached illuminator, 115 V	555
-bacteria colony counter, lens 12 cm, standard 1.5 x magnification, 115 V	128
-electronic register for colony counter, transistored, with probe, 4-digit counter, with sterilizing well, 115 V	161
-Waring blendor, with stainless steel container of 1 000 ml, and lid; 12 600/20 500 rpm, 115 V	63
-2 spare jars for Waring blendor, stainless steel or aluminium, 1 000 ml, with lids ($50 each)	100

Equipment (continued) (apparatus)	U.S.$
-incubator, gravity convection, with automatic temperature control in 30-65°C range, with thermometer, outside 0.6 x 0.6 x 1 m, 200 W, 115 V	239
-low temperature incubator, with heater blower unit, refrigeration unit, thermostats, for 5-50°C ± 1°C, outside 0.75 x 0.6 x 1.6 m, 720 W, 115 V	550
-refrigerator with a freezer compartment, household type, 2 doors, 360 l, 115 V	300
-3 burners, Bunsen, pilot flame, with stopcock and air regulator ($7 each)	21
-serological water-bath, for 30-100°C ± 0.3°C, with hydraulic thermostat and immersed heaters, no moving parts, inside 70 x 25 x 20 cm, 115 V	225
-anaerobic culture jar, stainless steel, chamber ∅ 13 x 20 cm, with 2 needle valves	70
-air ejector-filter pump, of brass, for water pressures from 0.8 kg/cm^2 up	3
-safety shower, ceiling-mounted, with an easy-to-reach handle to release the shower valve	50
-eye wash spray with a 2 m long flexible hose to be connected directly to water main, with handle operated valve	48
-fire extinguisher, for flammable liquid and electrical equipment fires, with 2.5 kg charge	27
-fire blanket with wall case, all-wool fire-proofed, 2 x 1.5 m	42
	$2 582
(glassware)	
-150 culture Petri dishes, bottoms and covers, chemically and thermally resistant, ∅ 100 x 15 mm, ($0.73 each)	110
-12 anaerobic culture dishes, with covers, ∅ 100 mm, ($65 dozen)	65
-40 serological pipets, reusable, assorted	60
-400 micro slides, 75 x 25 mm	20
-Four 1-oz boxes micro cover glasses, 0.19 to 0.25 mm thick	10
-500 test tubes, bacteriological, standard dimension 75 x 12 mm	40
-assorted glassware, such as flasks, beakers, funnels, etc.	300
	$605

Equipment (continued) (miscellaneous)	U.S.$
-inoculating needles and loops, assorted	30
-dissecting set, consisting of forceps, scissors, knife, cartilage knife, needle holders etc. in a case	10
-6 boxes of 100 microscope slides, ($15 dozen)	15
-assorted small metal, rubber and plastic laboratory equipment like tripods, supports, stoppers, tubing, spatulas, etc.	150
-micro slide 4-bar staining rack, with staining tray, holds 22 micro slides, stainless steel, 4 leveling screws	27
-2 waste baskets, polyethylene	6
	$238

Culture media kitchen

This room is used to prepare culture media needed in the microbiological laboratory, to carry out any other sterilization work and to supply distilled water needed for the whole quality control laboratory. The suggested minimum dimensions are 3 x 3 m = 9 m^2. The kitchen primarily serves the microbiological laboratory and is complemented by a glassware washing room, store and service area for the laboratory as a whole.

Furniture	U.S.$
-sink assembly, complete with a chemical resistant basin, cupboard, plastic top, double faucet, 0.9 x 0.55 x 0.9 m	385
-2 table units, with 0.9 x 0.55 m plastic tops and one drawer each; standing-height ($105 each)	210
-cupboard unit, with plastic top, 2-door storage spaces, 1.2 x 0.55 x 0.9 m	135
-floor case, with glass in steel frame sliding doors, about 3 m^2 shelf storage surface, 1.2 x 0.4 x 1.8 m	262
-laboratory stool, high model, adjustable 55-75 cm	26
	$1 018

Equipment (apparatus)	U.S.$
-sterilizing autoclave, vertical, electrically heated, stainless steel boiler, with a pressure gauge, safety valve and thermometer, ⌀ 35 x 65 cm, 2 kW, 115 V	510
-hot-air sterilizer, electrically heated, gravity convection, maximum temperature 200°C, inside 76 x 46 x 60 cm, 1.3 kW, 115 V	250
-balance, top-loading, with taring device, optical scale, capacity 1.300 g, precision ± 0.005 g, has a built-in set of weights	760
-distilled water still, capacity 4.5 l/h, electrically heated, 2.6 kW, 115 V	245
-heating unit for water still, spare, 115 V	33
-automatic cut-off for water still; prevents the passage of current into the heaters unless they are properly immersed, for 115 V	150
-3 boxes for sterilized culture Petri dishes, stainless steel, each holds 12 dishes of 100 x 15 mm, with a removable tray ($10 each)	30
-2 boxes for sterilized pipettes, stainless steel, ⌀ 5 x 40 cm ($6 each)	12
-test tube supports and baskets, corrosion-proof metal, assorted	50
-2 burners, Bunsen, pilot flame, with stopcock and air regulator ($7 each)	14
-stopwatch, interval timer, up to 60 min	12
-laboratory wagon for glassware, chrome-plated steel frame, with ball-bearing, rubber-tired castors, 2 asbestos shelves 90 x 50 cm	80
-fire extinguisher, for flammable liquid and electrical equipment fires, with 2.5 kg charge	27
-fire blanket, with wall case, all-wool fire-proofed, 2 x 1.5 m	42
	$2 215
(miscellaneous)	
-2 waste baskets, polyethylene	$ 6

Chemical laboratory

This laboratory is to carry out the chemical analysis needed to support the applied research for the fish utilization industry, particularly in the area of products development and fish handling and storage problems, as well as to assist the fish inspection service. The suggested room dimensions are 8 x 7 m = 56 m^2, and one wall provided with large windows should face north. Central glassware washing room, store and service area complement this laboratory.

Furniture	U.S.$
-fume hood, with a motor-blower, mounted on a cupboard unit, 1.2 x 1.0 x 2.4 m, with gas, water and electricity outlets, 0.35 kW, 115 V	1 170
-2 sink assemblies, complete with chemical resistant basin, cupboard, plastic top, double faucet, 0.9 x 0.55 x 0.9 m ($385 each)	770
-6 cupboard units, with plastic top, 2-door storage space, 1.2 x 0.55 x 0.9 m ($135 each)	810
-12 table units, with 1.2 x 0.55 m plastic tops and 2 drawers each; standing-height ($115 each)	1 380
-4 laboratory stools, high model, adjustable 55-75 cm ($26 each)	104
	$4 234

Equipment (apparatus)	
-balance, top-loading, with taring device, optical scale, capacity 1.300 g, precision ± 0.005 g, has a built-in set of weights	760
-drying oven, wall mounted, 50-200°C, ± 0.5°C, load surface 0.6 m^2, 95 x 50 x 58 cm overall, 1.5 kW, 115 V	395
-furnace, muffle, electric, with pyrometer and heat controller, up to 1 000°C, ± 10°C, chamber 10 x 9 x 11 cm, 1 kW, 115 V	108
-water bath, electrically heated, copper, 4 openings, 1.1 kW, 115 V	145
-extraction heater and support, electrically heated, 6 units, with support rods and clamps, 6 x 50-300 W, 1.8 W, 115 V	295
-6 extraction apparatus, Soxhlet, with inter-changeable ground joints, includes condenser, extraction tube and flask 250 ml ($33 each)	198
-3 burners, Bunsen, pilot flame, with stopcock and air regulator ($7 each)	21
-microdigestion Kjeldahl shelf, electrically heated, 6 unit, with borosilicate glass fume duct, 1.2 kW, 115 V	155
-micronitrogen distillation apparatus, Kjeldahl, including support, evacuated jacket distilling flask, funnel, condenser tube and jacket, vapour vessel, and receiving flask without burner	130

Equipment (continued) (apparatus)	U.S.$
-Waring blendor, 10 000 rpm, glass container of 1 000 ml with cover, 115 V, and 3 replacement containers with covers	50
-hot plate magnetic stirrer, hot plate 18 x 12 cm, 60-500°C; stirrer 80-1 400 rpm; 0.6 kW, 115 V	98
-airejector-filter pump, brass, for water pressure from 0.8 kg/cm^2 up	3
-first-aid kit for industrial laboratories having up to 20 workers, wall mounted, with assorted first-aid material and first-aid instruction chart	20
-safety shower, ceiling mounted, with easy-to-reach handle to release the shower valve	50
-eye wash spray with a 2 m long flexible hose to be connected directly to water main, with handle operated valve	48
-fire extinguisher, for flammable liquid and electrical equipment fires, with 2.5 kg charge	27
-fire blanket, with wall case, all-wool, fire-proofed, 2 x 1.5 m	42
	$2 545
(glassware)	
-6 flasks, round bottom, takes rubber stopper, 1 000 ml ($1.80 each)	11
-6 flasks, flat bottom, short neck, ground joint, 250 ml ($3.40 each)	20
-3 washing bottles, 1 000 ml, consisting of heavy ring-neck flask, rubber stopper and 2 bent glass tubes ($4 each)	12
-12 flasks, Erlenmeyer, polypropylene for colour change titrations, 250 ml ($1.15 each)	14
-6 flasks, Erlenmeyer, graduated, 250 ml ($0.60 each)	4
-6 flasks, Erlenmeyer, graduated, 500 ml ($0.80 each)	5
-6 flasks, volumetric, ground glass stopper, calibrated 'to contain', 100 ml ($4 each)	24
-3 flasks, volumetric, ground glass stopper, calibrated 'to contain', 250 ml ($4.90 each)	15
-3 flasks, volumetric, ground glass stopper, calibrated 'to contain', 1 000 ml ($7.60 each)	23
-6 weighing bottles, low form cylindrical, 50 ml ($3.90 each)	23
-2 filtering flasks, with side-tube capacity 250 and 500 ml	5

Equipment (continued) (glassware)	U.S.$
-3 connecting distilling tubes with thermometer opening, ground joints ($7.90 each)	24
-3 condensers, Allihn, jacket 400 mm, with ground joints, ($15 each)	45
-3 condensers, Mohr, jacket 400 mm, with ground joints ($10 each)	30
-30 beakers, heavy duty, low form, with spout, assorted by capacity from 100 to 1 000 ml	45
-desiccator, with tubulated cover for a rubber stopper, ϕ 150 mm, and porcelain plate ϕ 142 mm	15
-desiccator, with plain cover, ϕ 250 mm and porcelain plate ϕ 230 mm	33
-3 burettes, with ground glass stopcock, meeting a high accuracy class, capacity 50 ml, subdivision 1/10 ml ($10 each)	30
-3 burettes, with ground glass stopcock, for routine use, capacity 50 ml, subdivision 1/10 ml ($8 each)	24
-20 pipettes, volumetric or transfer, graduated 'to deliver', assorted by capacity from 1 to 100 ml ($2.25 each)	45
-10 graduated cylinders, calibrated 'to deliver', assorted by capacity from 10 to 1 000 ml ($3 each)	30
-4 salimeters, calibrated to read direct percentages of salt, 0-26.4%, 300 mm ($2.50 each)	10
-4 salimeter jars, 325 x 38 mm ($2.75 each)	11
-2 drying tubes, U-shaped, Schwarz, glass stopper, with side tubes, 150 mm high ($5.50 each)	11
-5 thermometers, general laboratory, subdivision 1°C, ranges -20 to 110°C, 0 to 50°C, 0 to 100°C, 0 to 250°C, 0 to 360°C	12
-5 funnels, Bunsen filtering, short stem, diameters 50, 75 and 100 mm	6
-6 crucibles, Gooch type, high form	22
-bottles, assorted reagent and dropping, 100 to 1 000 ml	30
-assorted miscellaneous glassware such as tubes, connecting tubes, rods, beads, watchglasses, test tubes, etc.	70
	$ 649

Equipment (continued) (miscellaneous)	U.S.$
-6 evaporating dishes, porcelain, assorted	9
-12 crucibles, porcelain, high form, with covers	10
-2 mortars, porcelain, with pestles ϕ 100 and 150 mm	7
-2 burette supports with double burette holders, with white porcelain base and metal rod ($17 each)	34
-apparatus support frame to assemble in laboratory, wall mounted, consisting of metal connectors and metal rods of various lengths, can be used to make frames up to 1.20 x 1.80 m	90
-assorted small metal laboratory equipment-like supports, holders, tripods, forceps, tongs, clamps, rings, etc.	60
-assorted small non-metal laboratory equipment such as rubber tubes, stoppers, etc.	25
	$235

Glassware washing room

This is the central area for the washing and drying of all glassware, except that used in the test kitchen and test panel room. The suggested size of the room is 3 x 3 m = 9 m^2.

Furniture	U.S.$
-2 table units, with 1.2 x 0.55 m plastic tops and 2 drawers each; standing-height ($115 each)	230
-3 sink basins of corrosion, heat, shock, and abrasion resistant plastic, 60 x 40 x 20 cm each with a double faucet, gooseneck and serrated hose connector ($108 each)	324
-wall case, with glass sliding doors, 1.2 x 0.3 x 0.75 m	127
-laboratory stool, high model, adjustable 55-75 cm	26
	$707

Equipment	
-pipet and test tubes washer and dryer, stainless steel, holds up to 200 pipettes, 115 V	105
-laboratory glassware dryer, wall mounted, 33 x 57 x 13 cm, 115 V	95
-fire extinguisher, for flammable liquid and electrical equipment fires, with 2.5 kg charge	27
-5 bottles with spigot, polyethylene, for collecting and dispensing distilled water, 9 l	55
-4 waste baskets, polyethylene	12
	$294

Store

This is intended as the central store to service all laboratories for the storing of apparatus, glassware, chemicals and other supplies. It should preferably have a ventilation duct, but no windows. The minimum floor area suggested is 3 x 3 m = 9 m^2. Shelving should be arranged along 3 walls.

Furniture	U.S.$
-8 m long metal shelving, 0.4 m deep, 2 m high, to assemble, with 6 adjustable height shelves, totalling 19 m^2 of storage space	200
	$200

Office

Services all laboratories. The suggested office room area is 3 x 3 m = 9 m^2.

Furniture	U.S.$
-office desk, plastic top, 1.6 x 0.8 m	220
-typewriter table	110
-chair to match the desk	25
-chair to match the typewriter table	20
-metal shelving, 2 x 0.4 x 2 m, to assemble, with 6 adjustable height shelves	50
	$425

Equipment	
-typewriter, office type, middle size	100
-electric calculating machine	450
	$550

Service area

This area includes corridors and sanitary rooms for staff. The total surface of the service area will vary significantly according to the general layout of the whole laboratory, but could be within the range of 30 to 80 m^2. Built-in wardrobes for coats etc. should be provided in corridors.

Equipment	U.S.$
-fire extinguisher, for fires in ordinary combustibles, flammable liquids and electrical equipment, with 10 kg charge	98
	$98

Cost estimate

Estimates of the cost of providing furniture and equipment for the whole laboratory, broken down into cost per unit, and in turn into cost per single room, are given in the table below. The costs are computed on the basis of approximate prices as mentioned in the equipment list, and the same reservations regarding their accuracy apply accordingly. No fixed cost is indicated for furniture. The lower figure of the range indicates the estimated cost at which it is assumed the furniture could be locally made in certain countries, and the higher figure indicates the cost of modern prefabricated laboratory furniture manufactured by specialized firms. In order to obtain an estimate of the total investment for the laboratory, costs for land and construction of the premises with installations should also be considered. Due to large fluctuations in building construction prices in different areas, no particular example has been quoted.

	Furniture	Equipment
	U.S.$	U.S.$
Fish examination room	250 - 700	1 770
Test panel room	350 - 800	300
Test kitchen	400 - 1 400	1 344
SENSORY EXAMINATION UNIT	900 - 2 900	3 414
Microbiological laboratory	450 - 1 300	3 425
Culture media kitchen	250 - 1 100	2 221
MICROBIOLOGY	700 - 2 400	5 646
CHEMICAL LABORATORY	1 100 - 4 500	3 429
Glassware washing room	200 - 700	294
Store	100 - 200	-
Office	200 - 500	550
Service area	-	98
SERVICES	500 - 1 400	942
TOTAL	3 200 -11 200	13 431

SAFETY CONSIDERATIONS

Some of the safety considerations pertinent to designing a laboratory have been listed below. They will be useful to a designer as a check list and it is proposed that he evaluates them and takes them, as well as other general safety measures, into consideration according to both the requirements of the particular laboratory being designed, and the prevalent local conditions. In many instances the manufacturers or distributors of such equipment provide engineering advice without obligation.

-Walls, doors and windows between laboratories and corridors should have a minimum fire resistance of 45 min, as determined by fire test ratings.

-There should be at least one 15-kg and one 2.5-kg fire extinguisher for fighting flammable liquid and electrical fires on each floor, and one 2.5-kg in each laboratory.

-Each laboratory should be equipped with at least one fire blanket.

-Safety centres where electrical, gas, steam, air and other utilities can be shut off should be located outside the laboratory rooms.

-At least one safety shower and eye wash fountain should be installed in each laboratory or near the entrance of each laboratory. There should be no more than 15 m travel distance to such devices from any point in the laboratory.

-Valves for gas, steam and air should be of the type that indicate at a glance if the valve is open.

-Each laboratory should have access to a first-aid kit.

-Consideration should be given to installing a 30 min self-contained breathing mask for use in emergency rescue operations. The air masks should be set in a permanent cabinet.

-Each laboratory should have one sink supplied with hand-washing material, so that persons using the laboratory can conveniently remove toxic materials before putting on their street clothes or going out of the laboratory for drinking, eating or smoking.

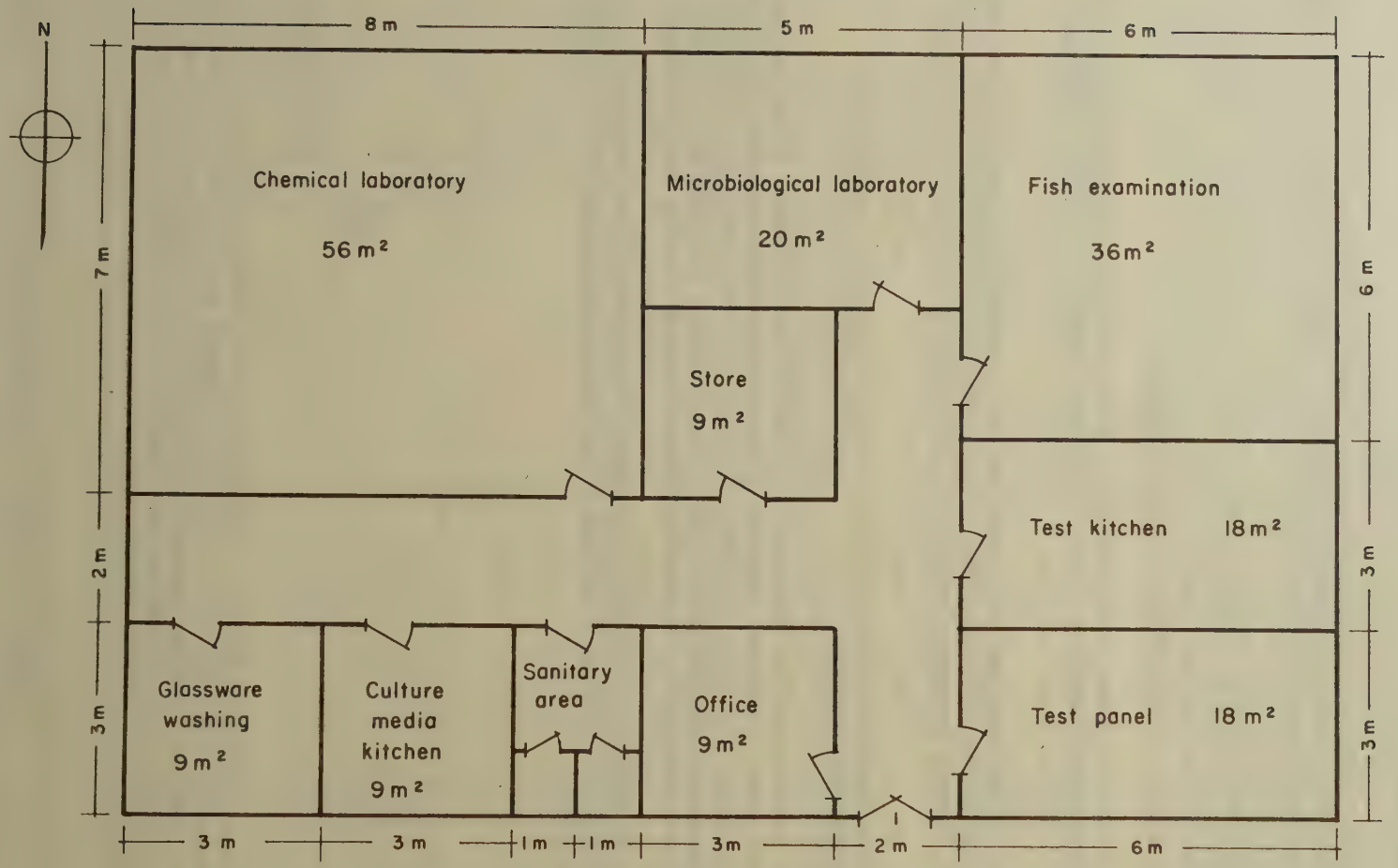
-Air exhausted from laboratories should not be recirculated in any other air-conditioning system or elsewhere.

-Laboratory fume hoods are often successfully used to remove gases, dusts, mists, vapours and fumes from laboratory operations preventing toxic exposures and flammable concentrations. To be effective a laboratory hood and its associated components must confine contaminants within the hood, remove them through ductwork and disperse them so that they do not return to the building through the fresh air supply system.

-Where necessary artificially ventilated chemical storage cabinets should be set up. They will require less air flow than fume hoods and can be exhausted by a separate system 24 h every day.

GENERAL LAYOUT OF A QUALITY CONTROL LABORATORY

Annex 1

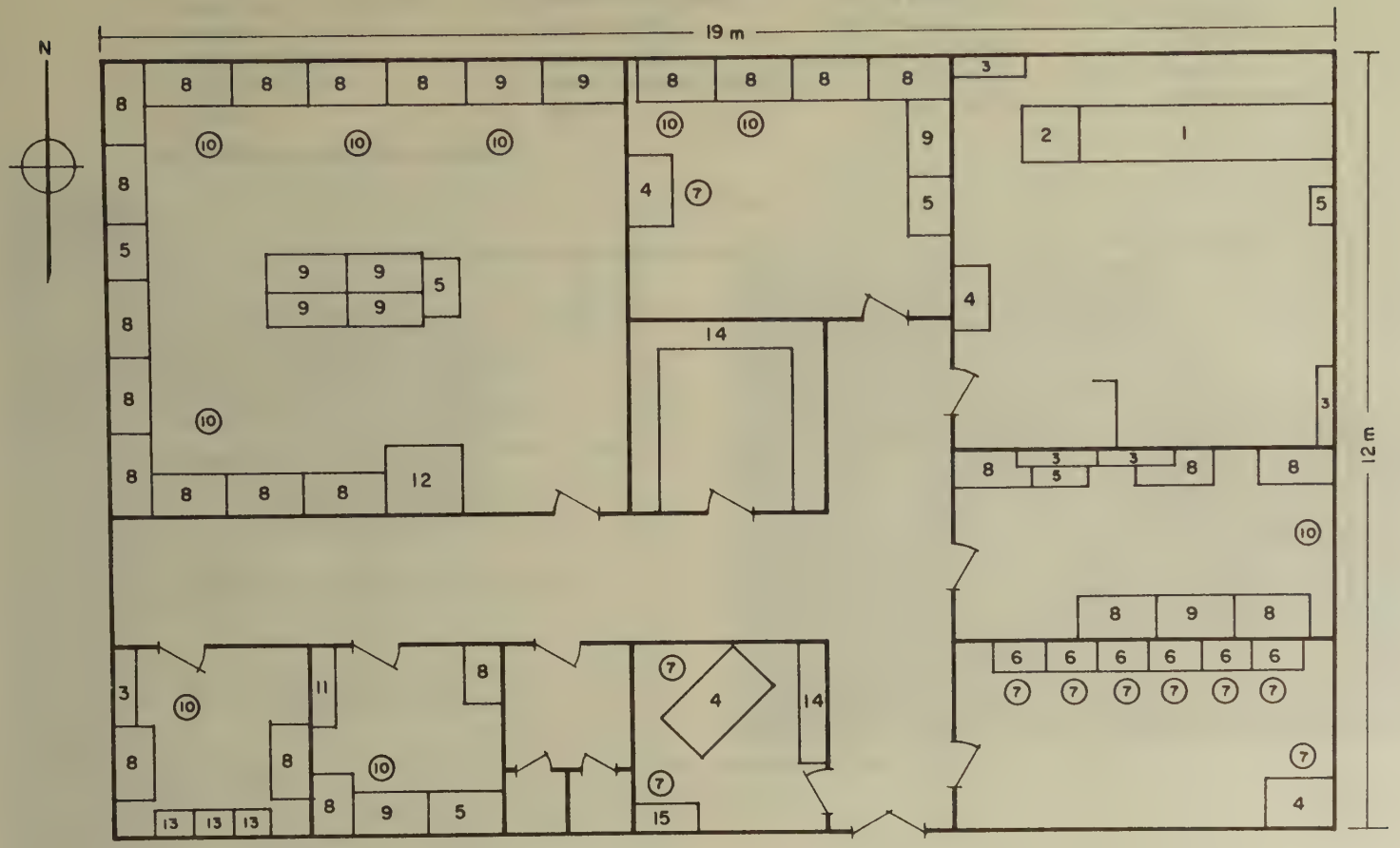


SCALE 1 : 100

Note: This layout does not represent a recommended design for construction of a quality control laboratory. It merely shows division of the total floor area between different rooms of an immaginary laboratory. Layout for a specific quality control laboratory should be prepared separately in each case taking into consideration requirements of the work to be performed in it.

LAYOUT OF LABORATORY FURNITURE

Annex 2



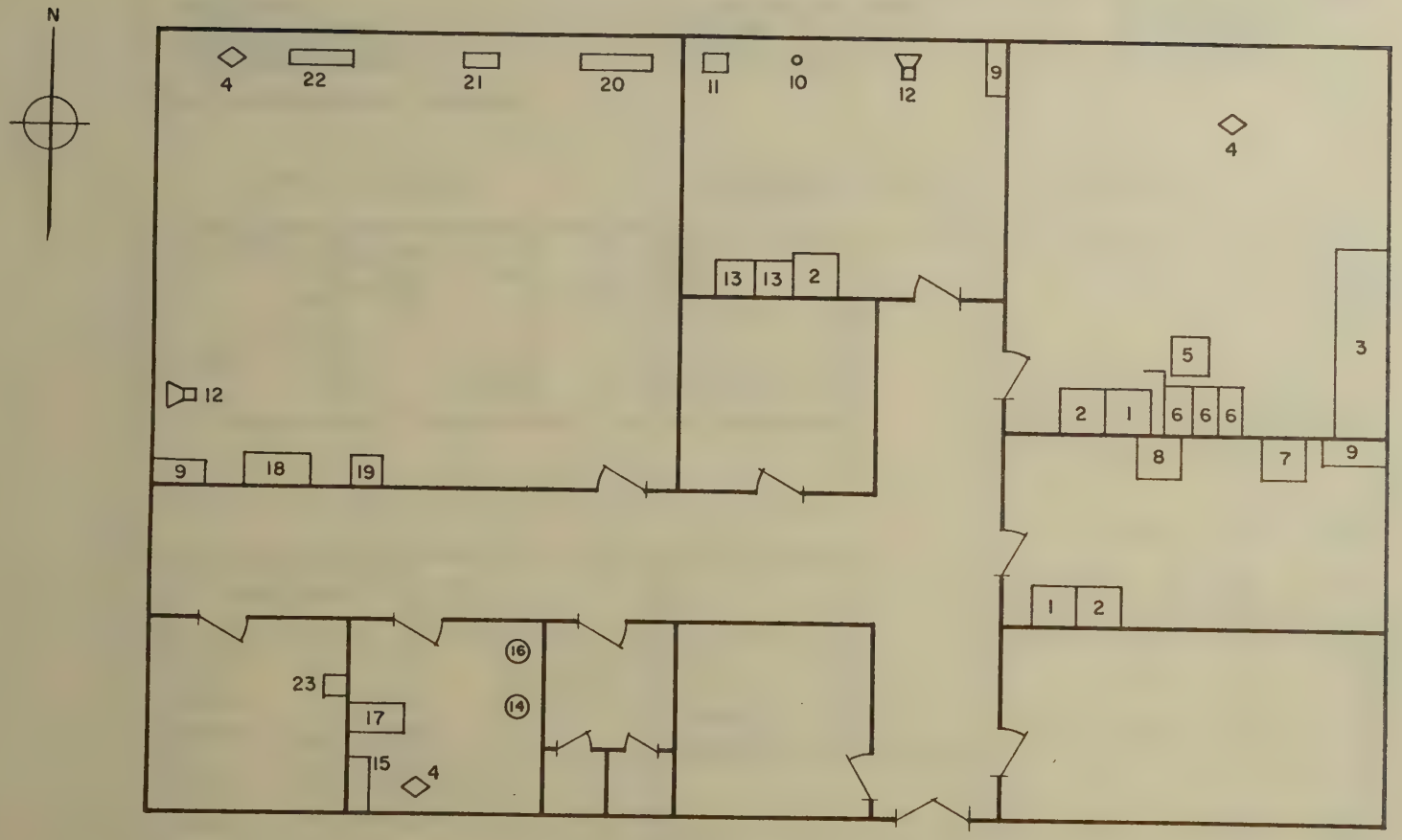
SCALE 1:100

Item identification numbers:

1 examination table
2 candling table
3 wall case
4 desk
5 sink assembly
6 panel booth
7 chair
8 laboartory table
9 cupboard
10 laboratory stool
11 floor case
12 fume hood
13 sink basin
14 shelves
15 typewriter table

DISPOSITION OF SOME LABORATORY EQUIPMENT

Annex 3



SCALE 1:100

Item identification numbers:

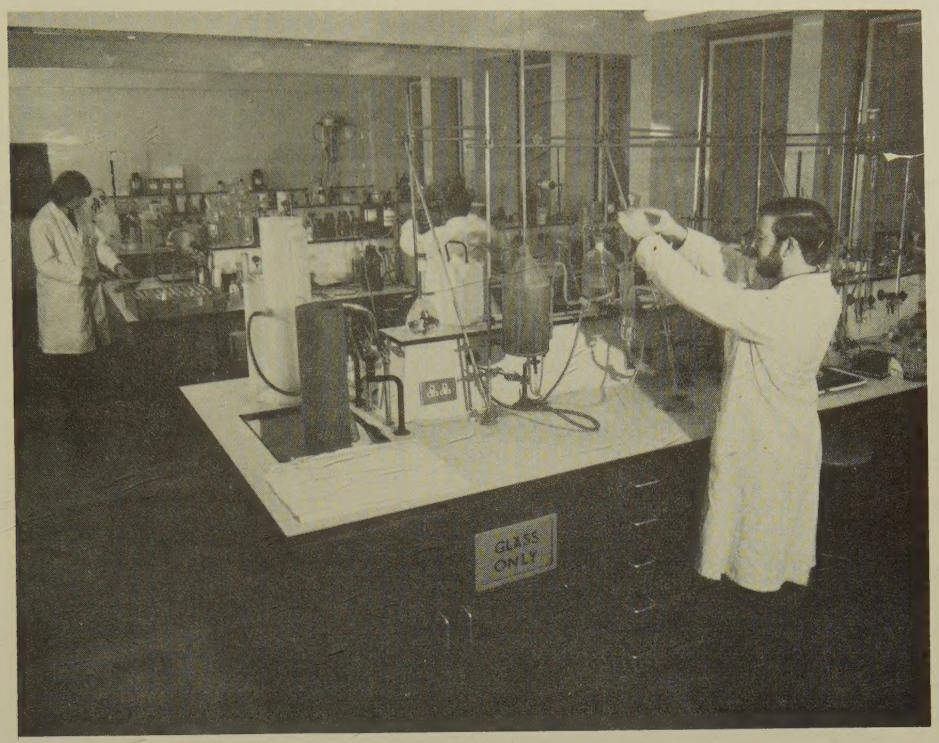
1	freezer	7	stove	13	incubator	18	drying oven
2	refrigerator	8	dish washing machine	14	autoclave	19	furnace
3	filleting table	9	water bath	15	sterilizer	20	Soxhlet
4	balance	10	microscope	16	still	21	Kjeldahl
5	insulated container	11	colony counter	17	laboratory wagon	22	burets
6	fish boxes	12	blendor			23	glassware dryer

PHOTOGRAPHS

Test panel member at work

An arrangement of a test panel room

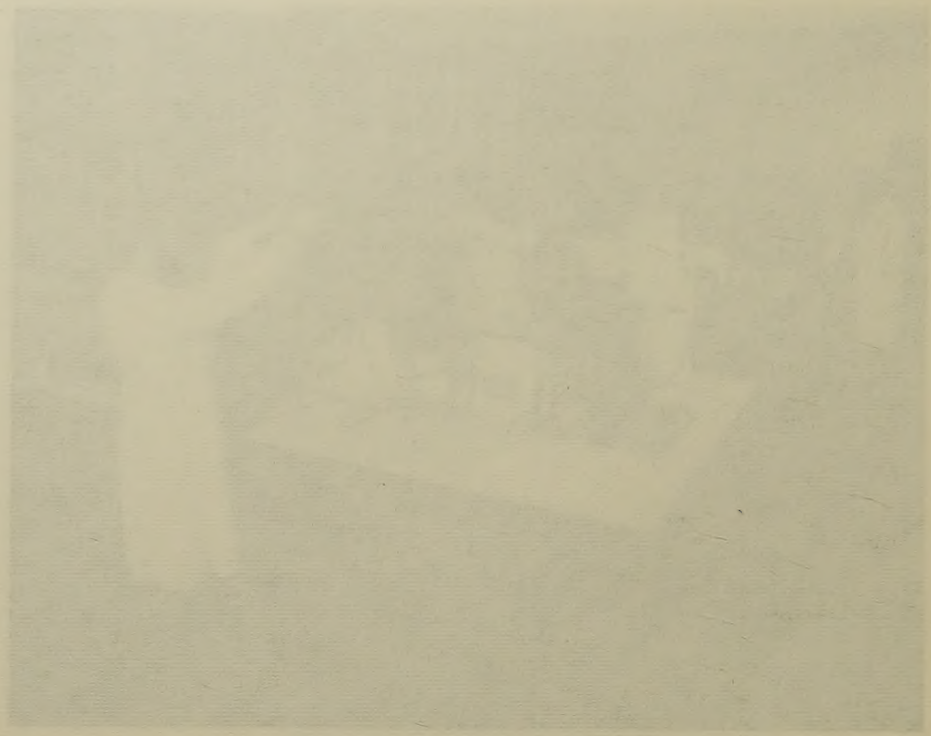
Courtesy:
Fiskeriministeriets Forsøgslaboratorium, Lyngby

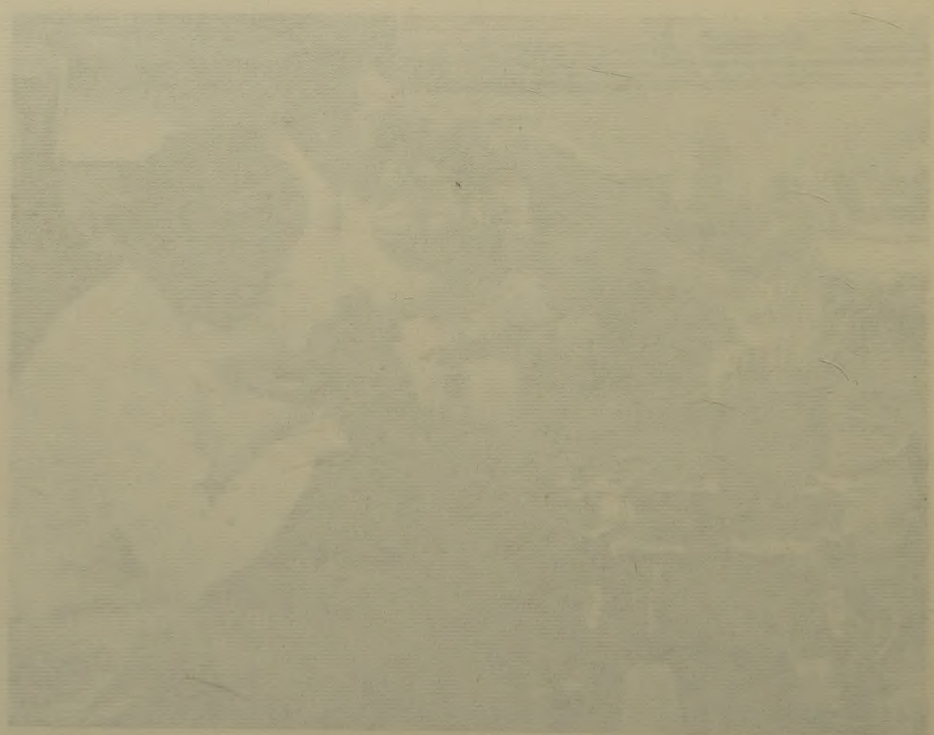


Partial view of a chemical laboratory

Partial view of a bacteriological laboratory

Courtesy:
Torry Research Station, Aberdeen





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